Dutch researchers explore advanced brain diagnostic techniques

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At present the task of diagnosing brain disorders using electroencephalography (EEG) is still performed by humans, but in years to come it will increasingly be taken over by computerized systems. This will then also enable us to monitor the brain better in critical situations, during surgery or in intensive care, said Michel van Putten upon his inauguration as Professor of Clinical Neurophysiology at the University of Twente, The Netherlands, on Thursday 10 December 2009.

Van Putten is a neurologist and clinical neurophysiologist at Medisch Spectrum Twente Hospital (MST). He specializes in the diagnosis and treatment of epilepsy, strokes and chronic pain. EEG is an important "measuring instrument" in patients with these conditions. Around 200,000 EEGs are performed and evaluated by medical personnel every year in the Netherlands alone.

During these EEG monitoring procedures doctors will in future increasingly be assisted by computerized systems, says Van Putten. This will be made possible by technological advances in the fields of digitization, modelling and simulation. Eventually, computer models may even completely take over the final evaluation from the doctor. "This will allow EEG measurements to continue for much longer periods, even for several days. This sophisticated system will improve not only our ability to diagnose epilepsy but also the entire process of monitoring brain function in Intensive Care."

EEG monitoring

Patients on the operating table or in intensive care run the risk of brain damage, especially as a result of problems with blood flow or epileptic activity. According to Van Putten, this risk is not always identified in time. "An EEG is ideal for monitoring brain function, but it is virtually impossible for the medical personnel to interpret in the conventional manner. The assistance provided by new computer models is invaluable, especially if the measurements go on for several days. This is time that could otherwise be spent providing other forms of care."

Van Putten has developed several quantitative EEG techniques for the purposes of EEG monitoring, one of them being the Brain Symmetry Index. BSI extracts the essential data from an EEG and then converts it into a clear signal, or even into written text. An initial prototype is already undergoing evaluation in an intensive care setting. Further development of this technique will take place in close collaboration with MST and the University Medical Centre in Nijmegen.

Simulation

Van Putten is investigating two other methods besides EEG monitoring: simulation and modelling. "Both will have a major bearing on the development of new treatment methods. In the same way as the surgeon is now already able to practise on a virtual patient, we neurologists will also be able to start by simulating the treatment of a number of conditions in a patient-specific model. Take epilepsy, for example. The percentage of patients who cannot be effectively treated with medication has remained static at around 25% for several decades. And with these patients it is currently often difficult to predict whether and how they will respond to antiepileptic drugs. Consequently the therapeutic effects are hard to evaluate. Simulation and modelling enable us to do this more successfully."

In addition, Van Putten is exploring a technique known as

neuromodulation. "Neurons, the basic building blocks of the brain, can start to behave 'incorrectly' in the brain or spinal cord. Neuromodulation is then a fascinating technique for modifying this behaviour. Several diseases of the central nervous system have great need of such 'correction'. This applies not only to epilepsy, but also to pain, depression or Parkinson's disease. In some cases spectacular results are achieved through neuromodulation."

The Chair of Clinical Neurophysiology at the University of Twente is unique, since all of the chairs established under that name hitherto have been attached to University Medical Centres. In the future, neurology and clinical neurophysiology will require increasing levels of technical input, emphasizes Van Putten. "The University of Twente is therefore responding to an urgent need with its Technical Medicine programme."

Provided by University of Twente